tion methods. More specifically, the microfluidic array devices of the present application can be manufactured by injection molding a suitable thermoplastic using conventional injection molding techniques. Suitable thermoplastics include polycyclic olefin polyethylene copolymers, poly methyl methacrylate (PMMA), polycarbonate, polyalkanes, polyacrylate polybutanol co-polymers, polystyrenes, and polyionomers, such as Surlyn® and Bynel®. Polycyclic olefin polyethylene co-polymers are particularly suitable for use in an injection molding process. Various grades of such polymers are commercially available from Ticona under the trade name Topas® (which is a polyethylene-polycyclic olefin co-polymer). Furthermore, polybutyl terephthalate (PBT) can be used, as well as polyamides, such as nylons of different grades (nylon 6-6, nylon, 6 nylon 6-12, etc.); polyoxymethylene (POM) and other acetyl resins; and other resins with melt viscosity comparable to PBT and other properties similar to the other suitable polymers disclosed herein. Generally, polymers that are suitable for use in the present injection molding process include those thermoplastic polymers with a relatively low melt viscosity and these polymers preferably also have a high chemical purity (preferably the polymers are without more than a few percent of particulate additives and are chemically inert). Other suitable polymers include thermoplastics blended with a lubricant (e.g., liquid crystalline polymers) added to help the flow and therefore this additive acts as a processing aid and other liquid crystalline polymers containing polymers such as Zenite® (DuPont Company) and the like can be used and polymers (both commercially available and non-commercially available) that have high chemical purity, high chemical resistivity and thermal stability are also suitable. In some applications, injection-moldable elastomers may also be suitable.

[0052] In order to manufacture the present microfluidic array devices using injection molding techniques, a mold or mold insert must first be fabricated. The following description of the mold is merely exemplary for one type of mold construction which is oversimplified in terms of its construction in order to illustrate certain details of overall molding process. However, one of skill in the art will appreciate that the mold structure is readily changeable and is dictated by the desired construction of the microfluidic device and more particularly, the desired construction of the microfluidic channels based on the shape, dimensions and other properties thereof.

[0053] The mold typically is formed of several parts that mate with one another to form an assembled mold. The mold or mold insert is typically formed as a negative impression of whatever channel architecture or device features are desired in the microfluidic array device. A polymeric material is injected into the mold and then the polymeric material is cured to form the microfluidic array device which is then removed from the mold. Typically, the mold is formed of two mold dies that mate together in a sealed manner and therefore after the microfluidic device has been formed and is sufficiently cooled, the two mold dies are separated to permit access and removal of the microfluidic array device.

[0054] The mold (i.e., mold dies) or mold insert can be prepared from any number of materials that are suitable for such use, such as metal, silicon, quartz, sapphire and suitable polymeric materials; and forming the negative impression of the channel architecture can be achieved by techniques, such as photolithographic etching, stereolithographic etching, chemical etching, reactive ion etching, laser machining, rapid prototyping, ink-jet printing and electroformation. With electroformation, the mold or mold insert is formed as a negative impression of the channel architecture by electroforming metal and the metal mold is polished (preferably to a mirror finish).

[0055] For non-metallic molds for injection molding, the mold can be made of a flat, hard material such as Si wafers, glass wafers, quartz or sapphire. The microfluidic design features can be formed in the mold through photolithography, chemical etching, reactive ion etching or laser machining (which is commonly used in microfabrication facilities). In addition, some ceramics can be used to fabricate the mold or mold insert.

[0056] Molds can also be fabricated from a "rapid prototyping" technique involving conventional ink-jet printing of the design or direct lithography of resists, such as Su-8 or direct fabrication of the mold with photopolymers using stereolithography, direct 3-dimensional fabrication using polymers, and other similar or related techniques that use a variety of materials with polymers. A resulting polymer-based mold can be electroformed to obtain a metallic negative replica of the polymer-based mold. Metallic molds are particularly appropriate for injection molding of polymers that require the mold itself to be heated. One commonly used metal for electroforming is nickel, although other metals can also be used. The metallic electroformed mold is preferably polished to a high degree of finish or "mirror" finish before use as the mold for injection mold. This finish is comparable to the finish obtained with mechanical polishing of submicron to micron size abrasives (e.g., diamond particles). Electropolishing and other forms of polishing can also be used to obtain the same degree of finish. Additionally, the metallic mold surface should preferably be as planar and as parallel as the Si, glass, quartz, or sapphire wafers. In one exemplary embodiment, the metallic mold is polished to a highly polished finish by using 1 micron diamond particles to provide a finish that is close to a mirror-like finish.

[0057] The present applicant has discovered that injection molding techniques using a mold fabricated of hardened steel or other metals can be used to manufacture polymeric microfluidic devices having an array of micron sized nozzle structures with a nozzle opening having a diameter equal to or less than 100 μm, preferably equal to or less than 50 μm and more preferably, equal to or less than 20 μm; and an outside diameter of the nozzle, as measured at a tip portion thereof, is less than about 150 μm and preferably is equal to or less than about 100 μm, and more preferably equal to or less than 50 μm. **FIG. 6** is a perspective view of a mold construction **200** that is constructed to injection mold a microfluidic nozzle array device, as shown in **FIG. 1**, having the aforementioned dimensions and properties. Once again, the mold **200** is formed as a negative impression of the microfluidic device that is to be formed. The mold **200** includes a first mold die or part **210** and a second mold die or part **230** that are constructed so that they are complementary to one another and mate with one another to form an injection mold assembly that is used to form a microfluidic nozzle array device, similar to device **10** illustrated in **FIG. 1**. The mold **200** is preferably formed by electric discharge machining (EDM).